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The Beijing Electron-Positron Collider and Industrial Technology

90FE0035A Beijing WULI [PHYSICS] in Chinese
Vol 19 No 1, Jan 90 pp 29-30, 61

[Article by Zhang Yan [4545 3508] of the Institute of High Energy Physics of the Chinese Academy of Sciences: "The Beijing Electron-Positron Collider and Industrial Technology"]

[Text] Abstract

The foundation of constructing a collider is high industrial technology. However, the construction of a high performance and high reliability will push the leading edge of industrial technology forward. In the past 25 years, the history associated with the development of high energy accelerators and high energy particle detectors fully illustrates this mutually benefiting cycle. The completion of the Beijing Electron-Positron Collider and its effect on industrial technology marks the beginning of this beneficial cycle.

It is only possible to develop high energy physics when we reach a certain level in industrial technology and social economics. As a high technology research project, the fact that it only took us four years from ground breaking to complete the Beijing Electron-Positron Collider is a good illustration of this fundamental fact.

Since the founding of the New China, a relatively comprehensive and complete industrial system has been established in the past 30 years. In machine building industry, defense industry and raw material industry, certain areas are at relatively high technical levels. This is one of the bases why the Central Government decided to design and construct the collider independently.

The overall design of the Beijing Electron-Positron Collider was completed in 1982. The main design specifications and the associated accelerator technology and detector technology represent world class level back in the early 80s. Thus, the project faced the following situation. There was the necessary basic condition in terms of level and capability in industrial technology. However, there were gaps to fill and key technical breakthroughs to make. The correct policy was, on one hand, to take full advantage of the favorable international cooperative environment in high energy physics to actively and selectively absorb and digest advanced foreign technology. To the extent possible, spread the technology to various industries. On the other hand, engineering projects were used to guide and promote domestic industry, especially the defense industry, to focus on the development of collider-related projects. In addition, we organized joint efforts, raised levels, and controlled technology to produce collider parts that met the requirements. Over the years, the above policy was thoroughly implemented during the construction of the collider.

Now, the collider has been constructed. It illustrates the fact that any high energy physics project must have

strong support from the industry. At the same time, through many things we personally encountered, another conclusion may be reached. High energy physics is also a major propelling force to promote, improve and develop industrial technology. This point has been repeatedly proven in past decades in the history of high energy physics projects throughout the world.

CERN (Centre Europeen de Recherches Nuclearire) has built high energy accelerator one generation after another for over 30 years. These large accelerator projects have a major impact on the development of industrial technology in western Europe. CERN has conducted wide-ranged and detailed studies on this soft science subject.

Businesses that signed contracts with CERN generally have been significantly affected in areas such as new booking volume, quality, productivity, replacement generation, cost reduction, internal cooperation, and business reorganization. In addition, CERN also made a great deal of effort to sponsor various types of exchange programs and form different levels of joint organizations with the industry in order to strengthen mutual understanding and cooperation. In April 1974, CERN held a three-day meeting involving 300 people from different industries, research institutions and universities. In the meeting, over 250 high technology projects were presented to enhance the understanding and contact with the industry. In 1979, the 25th anniversary of CERN, a technical achievement exhibit was held with a display area covering 600 m². In 1985, it created an "Industrial Relations Committee" dedicated to exploring the cooperative prospect and technology transfer with industry. In the past 2-3 years, a variety of specialized technical organizations have been established to further strengthen industrial technology exchange and cooperation.

In China, the Beijing Electron-Positron Collider is the first accelerator project ever constructed. There is only a short history. Furthermore, based on the breadth and depth of the technology, the impact on industrial technology is at a lower level. In addition, there is not sufficient time to perform a widespread, in-depth study to investigate, analyze and summarize the effect of the collider on China's industrial technology. This paper is a preliminary wide-ranged discussion of the issue with a limited scope.

Accelerator and detector technology essentially involves the transfer, development and consolidation of nuclear technology (including the physics of electricity and nuclear electronics), radar technology, radio and television broadcasting, vacuum technology, special electrical machine building, precision machining and specialized machining, computer technology, automatic control and precision engineering measurement technology. The development and manufacture of special equipment used in the collider project had undoubtedly cause improvements and breakthroughs in industrial technology to different degrees in the areas mentioned above.

The following are a few examples. The highest level of S-band high power klystron in China was at 15-20 MW pulsed power output. The mean operating life was under 1,000 hours. It could not meet the requirement for the project. As a result of a close cooperation between research institutes and factories over several years, we have absorbed and digested the manufacturing technology and quality assurance measures associated with the product in other countries in the early 80s. The production line was gradually upgraded. The power of klystrons produced currently is 34 MW, an increase of nearly one-fold and close to foreign levels in the early 80s. The operating life has also been significantly lengthened. In the collider, because the injector is only required to provide 1.1 GeV at the front end, the 16 klystrons do not have to operate at their rated power level. With the exception that two are operating at 22 MW, the rest of them are below 20 MW. They have delivered over 7,000 hours of service and are still functioning well. Although the actual mean operating life has to be assessed over a long period of time, however, it is obvious that its operating life has been improved. Not only the level of domestically made klystron is significantly improved, but also the level of high power electrical vacuum devices in China can be advanced if the corresponding technology and measures can be extended. This has a significant impact on the economy and the defense industry. For example, due to using this technology, the quality of the 30 kW wide band continuous wave color TV klystron has been significantly improved. As another example, a 10 us pulse width klystron was required for the "free electron laser" project in high technology tracking. In spite of its high degree of difficulty, China has the capability to conduct research and development on this type of tubes. Of course, this type of klystron has reached 50 MW in other countries and the life is guaranteed at 20,000 hours. Therefore, there is still a considerable gap.

China had the capability to produce disk waveguide accelerator tubes, primarily for use in medical accelerators. The capacity was four month per section. Further, the quality and performance were unstable. As a result of the collider project, there is a steady capacity to produce four sections per month and the quality is stable and the yield is high. The performance is comparable to the world class level. This technology and its associated production technique is worthwhile for the national economy.

The 240 m circumference high volume storage ring is an ultra-high vacuum aluminum chamber at a static vacuum of 10^{-10} Torr. This was three orders of magnitude higher than the level we were at back then. Presently, the required high-speed ultra-high vacuum sputter-ion pump and distributed ion pump are at world level and can be manufactured in quantity. Based on one full year of operation, this system was found to perform satisfactorily and reliably. This not only gives us an opportunity to develop a new series of products but also,

more importantly, provides a solid foundation for the development of several high technology projects in China.

The batch production of high field, high precision magnets and the successful development of 4.2 m diameter large solenoid coil that weighs 31 tons (both are at world class level) pushed our electrical engineering industry and accelerator industry into new technical territories. This enabled us to have the capability to bid on projects worldwide. High precision injection molding technology, lamination technology, insulation technology and bulk curing technology are worthwhile promoting for the economy. Breakthrough has been made in high current, high stability power supply technology. In the past, it was only possible to build a constant current power supply up to several hundred amperes with a stability of 10^{-4} . Now, there is a series of products ranging from several hundred to 4,000 amperes with 10^{-5} stability. It is comparable to the world class level. The power output of the 4,100 a constant current power supply is 1.2 MW, which is the first high power, high stability constant current power supply. The major problem is that the quality of the components is not consistent, which affects the breakdown rate. This problem will have to be solved by rigorously screening the components.

Double-gap deuterium-filled pulsed thyatron is a key component of the pulse modulator that goes with the high power klystron. It is a consumable component and was imported from abroad. As a result of the collider project, advanced foreign technology was absorbed and digested. A double gap deuterium-filled pulsed thyatron with 50 kV maximum peak anode voltage and 5 kA peak current has been successfully developed. Its major specifications have met those of similar devices made in other countries in the early 80s. It is already in production. Since a year ago, domestically made thyatrons have been used to replace imported ones and have passed tests under load. The major gap is in operating life. Foreign made thyatrons generally last a few thousand hours and domestically made ones last close to 1,000 hours.

The technology associated with the large universal detector, a high precision device in the Beijing spectrometer, is very complicated and unique. It is one of a few units in the world. Most parts were developed by the industry for the very first time. Due to a wise selection of factories, we were able to take advantage of their strength. A close cooperation between research institutions and factories resulted in the effective absorption of relevant foreign technology and experience. After taking the specific situation of individual factory into consideration, through various simulations and focussed efforts, we began to gain control over technology by continually summarizing our experience and innovation. This cutting edge task has been successfully completed. The major specifications of the Beijing spectrometer have reached advanced world case level. Since the components developed are not sold as special products, the

benefit gained is indirect and hidden. First, the contracting plant expanded its scope of knowledge and field of technology. For example, large drift chamber manufacturing technology, laminar bonding and bundle technology, and wiredrawing technology will form a technology reserve to facilitate the replacement, expansion and development of future products. Furthermore, the first line technical team got a chance to practice its skills. More importantly, any business that successfully completed the development and production of key components or equipment associated with a high energy accelerator or large detector essentially passes a publicly recognized technical review. It will benefit in future international bidding of major contracts. This type of unwritten rule exists in Europe, the U.S. and Japan.

Due to lack of foundation, high investment, and long development cycle, the core parts of the accelerator computer control system (including a large number of software) and the electronic read-out system for the

spectrometer were imported. We have grasped this technology at a very limited expense and will continue our development and application process.

In conclusion, the successful completion of the design and construction of the Beijing Electron-Positron Collider is a major step in high energy physics in China. It not only pushed a variety of industries forward in a number of special technology areas toward world class level, but also, more importantly, gave foreigners a new perspective at China's industrial and technology level. Some foreign research institutions have requested for key assemblies of accelerator components. We believe that China has already systematically controlled the technology associated with the construction of high energy accelerators through the construction of the collider. As our industrial technology advances further, it will be possible to export accelerator equipment and software, or even building the entire accelerator for other countries.

Low-Temperature Skin Preservation Said Successful*90FE0016M Shanghai WEN HUI BAO in Chinese
23 Dec 89 p 1*

[Article by Hu Derong [5170 1795 2837]]

[Text] In a joint effort by the Shanghai Burn Research Institute and the Low-Temperature Bioengineering Laboratory of the Shanghai Institute of Mechanical Engineering, a method was found to preserve the skin in deep freeze without losing the skin's vitality. This method can satisfy the clinical needs of large-area coverage of burn patients and surgical reconstruction.

In treating third-degree burns, the ideal temporary biological coverage is paramorphic or xenogeneic skins. However, since the burn damage is often accidental, the hospital is often unprepared.

With the help of Professor Hua Zejian [5478 3419 0494] of the Shanghai Institute of Mechanical Engineering, researchers Feng Shijie [7458 0013 2638] and Fang Peiyue [2455 1014 6460] at the Shanghai Burn Research Institute optimized the procedure for preserving skin at a low temperature. The skin removed by the skinner is first soaked in a maintenance solution prechilled to 4°C, and after 2 hours the solution and the skin are dumped into a plastic bag, the bag is then sealed and the temperature is dropped to -60°C at a rate of 1 degree per minute. The preparation is then placed in a liquid-nitrogen dewar at -196°C. When ready to use, the skin is removed from the low-temperature storage and softened in 40°C warm water and then used for covering damaged skin. From electron microscope and physiological observations, skin preserved in this manner had 71.3 percent of its original vitality.

Monoclonal Antibody Application in Poultry Epidemic Diagnosis Studied*90FE0016L Shanghai JIEFANG RIBAO in Chinese
14 Jan 90 p 6*

[Article by Ni Hau [0242 3185]]

[Text] Instructors at the Shanghai Agriculture College successfully applied monoclonal biotechnology to the treatment of poultry epidemic. The project entitled "A Study of the Bursa of Fabricius Inflammation Poultry Epidemic Virus Monoclonal Antibody," led by Associate Scientist Lu Ping [7120 5393] of the Biotech Research Laboratory No 1, has recently been certified.

Inflammation of the Bursa of Fabricius in poultry is one of the major epidemics on chicken farms. It often causes a high fatality rate in young chicks, sometimes as high as 40 percent. Although this disease has attracted attention here and abroad, research on prevention and diagnosis has not been very successful. In order to find an effective cure, Lu Ping and co-workers launched into this difficult task.

They conducted extensive diagnosis and treatment tests in a suburban chicken farm. The results show that the

monoclonal antibody was not only effective in diagnosing the disease accurately, but was also effective in treating the disease in AA chicken, Sanhuang chicken, and Ross chicken by oral administration of the drug. The overall effectiveness was 80 percent and the drug greatly increased the survival rate of the chickens.

Experts feel that this high-tech research result has broken through the traditional serology testing system and achieved immunization and treatment of chickens. It has opened a new page in the direct application of biotechnology to chicken farming and production.

China's Largest Pharmaceutical Company To Be Expanded*90FE0016K Shanghai JIEFANG RIBAO in Chinese
19 Jan 90 p 1*

[Article by Zheng Fan [1767 1581]]

[Text] The Minxing [7036 5887] facility of the Shanghai Biochemical Pharmaceutical Plant was completed and passed inspection yesterday.

The Shanghai Biochemical Pharmaceutical Plant is China's largest pharmaceutical plant. In the past, this plant was housed in run-down buildings. The equipment was crude and obsolete, and the operation was scattered in a dozen different locations. The poor conditions severely hampered productivity. The production of urine-product ampoules could not satisfy domestic demand, let alone the hungry international market. In order to change that situation, the plant decided to build its expansion facility in Minxing and had the ground-breaking in 1985.

The goal of the "Minxing" project was to build a modern pharmaceutical plant meeting international standards. It consisted of four tasks: the urine product laboratory, the ampoule laboratory, the importing of advanced equipment, and an animal experiment building. After 1 year of test production, the quality of the products completely meets the pharmaceutical codes and export standards. The products have been put on the international market.

After the expansion, the production capacity and output value of the Shanghai Biochemical Pharmaceutical Plant will grow by leaps and bounds.

Cell-Free Pertussis Vaccine Developed*90F0016J Beijing GUANGMING RIBAO in Chinese
30 Dec 89 p 1*

[Article by Liu [0491]]

[Text] A new vaccine for preventing pertussis in children—the adsorption refined cell-free pertussis vaccine—has recently been successfully developed in China. Ever since the 1930's, the whole-cell pertussis vaccine widely used throughout the world has provided a high level of protection, but its toxicity is high. The research group led by He Changmin [0149 7022 3046] in the

Lanzhou Institute of Biological Products under the Ministry of Public Health has borrowed Japan's experience and applied it to the situation in China for the past 3 years. The cell-free pertussis vaccine recently developed in China contains leukocytosis-promoting factor (LPF) and filamentous hemagglutination agent (FHA), needed to prevent infection, but does not contain internal toxin and thermally unstable toxin that can lead to abnormal reactions. The vaccine quality meets the Japan biological product codes and international standards.

Pure Human Tumor Necrosis Factor (TNF) Produced

90FE00161 Beijing GUANGMING RIBAO in Chinese
2 Jan 90 p 1

[Article by Li Guoyan [2621 0948 3508] and Zhang Yifu [1728 6318 1788]]

[Text] After 3 years of work, Associate Professor Li Changben [2621 2490 2609] and his research group at the Fudan University Genetic Engineering Laboratory have achieved a difficult world-class high-tech result. Using sections of genes separated from a gene bank, they constructed the engineered bacteria that produce the human tumor necrosis factor (TNF), which has a high expression in mammal cells, yeast and E coli. In small-scale fermentation tests, they have for the first time produced 95-percent-pure TNF. Tests show that the activity of the TNF has reached the international standard for similar drugs. This major result in genetic engineering has recently been certified in small-scale testing conducted by the Shanghai Municipal Science Committee.

Biotechnology is one of the focal points in high-tech development during the next century. At the present time about 70 percent of the biotechnology effort in the world is devoted to the medical area, and tumor treatment drugs are one of the hot topics. Since the mid-1980's, the United States, Japan, and the FRG have actively developed the production of TNF with genetic engineering methods. This is a new form of effective drug against tumors. When TNF is injected into the tumor or around the tumor, it can effectively cut off the nutrient supply to the tumor cells and cause them to die. Some have regarded it as a cure for tumors. In addition, TNF can kill transformed cells and cells affected by virus, but will not harm normal cells; in fact, it can stimulate the growth of normal cells. In some countries TNF produced with genetic engineering has been used clinically. Many of the cancer patients have shown various degrees of improvement, and the tumors in some patients have actually completely disappeared.

Since the early TNF was extracted from humans, the quantity was extremely limited and the price was prohibitive. Based on the June 1989 price quoted by some U.S. companies, the price of TNF was 2 million times that of gold. Because of this, there was simply no research on cancer treatment by TNF in China. Now, with the results obtained by Professor Li, medical and research units in China will before long have access to TNF products at reasonable

prices for the development of medicine in China. This has also opened a new avenue for China's tumor treatment effort.

Results of Plant Experiment in Space Reported

90FE0016H Beijing RENMIN RIBAO [PEOPLE'S DAILY] in Chinese 30 Jan 90 p 1

[Article by Zhang Xuequan [1728 1331 0356]]

[Text] Shanghai, 29 Jan (XINHUA)—When an ordinary species of wheat was put on an artificial earth satellite and then brought back to earth, it became a slightly different species.

This reporter has recently seen the third-generation mature plant of such "space wheat" in a laboratory. The ear and stamen of the wheat appeared no different from ordinary wheat but the most obvious difference was that the space wheat was only about 1 foot tall.

According to the experts, after three generations of breeding experiments with the space wheat, the technique of putting wheat on the satellite has produced satisfactory results. Experts say that the experiment was part of space life-science research. Scientists at the Shanghai Institute of Plant Physiology of the Chinese Academy of Sciences [CAS] began this project in 1987 and sent three batches of dry wheat seeds to space and planted them upon returning to earth. They made physiological and cell biological studies by observing the morphological, physiological, and genetic changes due to the influence of zero gravity and cosmic-ray radiation.

Studies show that the germination of the space wheat is no different, but there are differences in three other areas. First, the growth is fast. The plants seen by this reporter were planted last September, and they are now ready for harvest after a mere 4 months or so. Second, there are micronuclei and chromosome bridges near its roots. These might be mutations caused by the bombardment of the seed germ by heavy particles in the cosmic rays. Such changes may be avoidable if the seeds are treated with chemicals before being sent into space. The third change is that although some plants become taller, more plants become shorter: from the original 70 cm to about 50 cm.

Scientists are currently looking for applications of these changes. It is anticipated that these experiments may lead to some better varieties of wheat to resist bending by wind.

Naval Medical Research Institute Profiled

90FE0016G Beijing BEIJING KEJI BAO [BEIJING SCIENCE AND TECHNOLOGY NEWS] in Chinese
2 Dec 89 p 1

[Article by Jiang Rubiao [3068 3067 2871] and Lu Huaqing [0712 5478 7230]]

[Text] China's only institute engaged in systematic research of naval military medicine—the Naval Medical

Research Institute—celebrated its 35th birthday at the end of November this year with a wealth of cumulated research results. Over the last 35 years the institute has undertaken research oriented toward the oceans, the islands, and naval vessels, and has completed a total of 470 research projects. Since 1978, the institute has received 11 major national science awards, 4 national S&T awards, and 152 army (provincial and ministerial) awards. It has contributed greatly to the establishment and advancement of China's naval medicine.

The Naval Medical Research Institute was established in November 1954. As the People's Navy grew over the years, the 18-person Naval Health Service Institute has turned into a general multidisciplinary research organization. It now has laboratories in radiation protection, diving, ship health, ship nutrition, naval health service, and naval air medicine.

Over the last 35 years, the institute has striven for world-class military medical standards and has achieved many "firsts" in China. These include China's first-generation diving pressure meters, the first ocean rescue package for pilots, the first negative-pressure experimental facility, the first serialized ship foods for extended sailing, the first local brain-flow measurement device, and China's first heat-flow and temperature automatic measurement system. The institute was the first to successfully implement China's deepest oxygen-helium dive experiment, and is responsible for the first saturation dive in the ocean, as well as for medical safeguards for the first fast surface rescue of a submarine crew member. Early this year the institute completed a 350-meter helium-oxygen saturation-dive experiment and a 374-meter cruising dive experiment, thereby setting a depth record in Asia for simulated saturation diving. The comprehensive project "Diving Medicine and Its Military Applications" was awarded first prize for national S&T advancement.

While developing naval medical research, the institute also has actively participated in defense and economic construction. It conducted the investigation of the sunken freighter "Yuejin," performed underwater construction at the Yangtze River bridge in Nanjing, and has participated in China's launches of missiles toward the South Pacific and in underwater launches from submarines, the first visit to three South Asian countries by a Chinese fleet, China's first scientific expedition to the South Pole, and the construction of a station on Yongshu reef in Nansha. The technical staff of the institute has written numerous papers based on their research and practice. In the last 5 years they have published 770 papers in technical journals within and without the military. In addition, they have written and compiled a number of books, including "Diving Medicine," "Chinese Navy Medical Geology," and "Atlas of Naval Epidemiology," and have contributed to China's exploration of the oceans.

Nuclear-Magnetic-Resonance Diagnosis System Developed

90FE0016F Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 28 Dec 89 p 1

[Article by Jia Xiaohui [6328 2556 1979] and Tang Shifen [0781 0013 5358]]

[Text] As this year ends, an exciting bit of news has come from the Shekou industrial zone in Shenzhen. A piece of large-scale high-tech medical equipment called a nuclear-magnetic-resonance (NMR) imaging system has passed the certification examinations jointly held on the 27th of December by the State Science and Technology Commission, the State Pharmaceutical Administration and the Chinese Academy of Sciences (CAS). This achievement is the result of 2 years of hard work by the Anke [1344 4430] Company and signals that China has the ability to enter the advanced international arena in research on and development of large-scale medical facilities.

The NMR imaging system is a large-scale high-tech medical imaging facility developed in the 1980's. The technology involved is sophisticated and there are only a few countries in the world with the ability to produce it. The ASP-015 NMR imaging system is the first such device developed in China. The hardware for the system and the domestically developed software are all designed in the modular fashion. The structure is compact and the system is reliable. The design of the 0.15-tesla permanent-magnet system is very unique. All the materials used in building the system are made in China, and the technical and economic specifications are superior to those of similar units broad. Compared to foreign models, the image quality is superior and the image post-processing capability is more complete. After rigorous and careful evaluation, the expert committee agrees that the ASP-015 NMR system meets advanced international standards of the mid-1980's for similar products. It has been reported that, from 1985 to 1988, China imported 20 NMR imaging systems from abroad at an average price of \$1.5 million per unit. From now on, China will be able to supply reasonably priced systems with guaranteed maintenance to 12 Chinese hospitals. This not only will save \$12.6 million for the country annually but is highly significant to the medical and health standards of 1.1 billion people.

The success of the ASP-015 system plainly proves the resourcefulness of the Chinese people and is the result of a combination of research, development, and production under the guidance of high technology. It is a success story of openness and reform and is based mainly on self-reliance, supplemented by international cooperation. CAS Deputy Director Hu Qiheng [5170 0796 1854] said at the certification meeting that: "If we simply rely on imports, we will always be lagging behind and the distance will be increasing. The approach taken by the Anke Company is along the path of scientific research integrated with production."

Spectinomycin Injection To Be Marketed

90FE0016E Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 11 Jan 90 p 2

[Article by the Academy of Medical Sciences]

[Text] The Medicine and Biotechnology Institute of the Chinese Academy of Medical Sciences has recently made advances in their research on spectinomycin. They expect to complete clinical studies in the near future and plan to market the spectinomycin injection for treatment of gonorrhea.

Among the sexually transmitted disease cases in China, 77.67 percent are gonorrhea. What is usually seen is the suppurational infection of the urological and reproduction systems caused by the gonococcus. In the past gonorrhea was usually treated with large doses of penicillin or other antibiotics. However, since the gonococcus has developed a resistance to penicillin, the treatment is no longer effective. In 1971, spectinomycin was introduced. It is particularly effective against gonorrhea and has low toxicity and high concentration in urine and blood; it is simple to use and the treatment period is short. The dosage is 2 grams for males and 4 grams for females in one injection in the muscle. It has no cross-resistance with penicillin and causes no allergic reaction. There have been reports in recent years of the dramatic effectiveness of spectinomycin against gonorrhea. At the present time, spectinomycin is produced only by the Upjohn Company in the United States and the price is high.

In the early 1970's, the Medicine and Biotechnology Institute of the Chinese Academy of Medical Sciences screened the soil in Hangzhou, found a specimen of actinomyces 1043, and verified that the antibiotic produced by this actinomyces is spectinomycin. At the time there was little use for this in China and it was therefore not studied or developed. In recent years the number of patients with sexually transmitted diseases has increased every year and the need for an effective new drug has become acute. Under the strong support of the State Science and Technology Commission and the Ministry of Health, research on spectinomycin was restarted and deepened.

Progress in Ribosomal Protein Study Reported

90FE0016D Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 20 Jan 90 p 1

[Article by Chen Jinwu [7115 6855 2976]]

[Text] Beijing, 19 Jan (XINHUA)—Chinese scientists recently verified experimentally that the effect of ribosomal protein on gene expression is only at the translation level. This discovery indirectly exhibits the function of ribosomal protein and further advances the understanding of life.

Scientists have found that protein and nucleic acids are the two pillars of life. DNA records the biological hereditary message in the form of a codon but cannot reveal the content of the hereditary message. The DNA codon must first be transcribed and translated before the hereditary message can be expressed by the different proteins. This is analogous to the translation of telegraphic codes into the telegram text. All biological proteins are synthesized on ribosome, and the detailed structure of ribosome is known; but almost nothing is known about the function of ribosomal protein.

From 1979 to the present, the research group led by Tong Kezhong [4547 0344 1813] at the Institute of Genetics under the Chinese Academy of Sciences [CAS] has separated and identified tens of ribosomal protein mutants from *E coli* and *Bacillus subtilis*. They have also studied the effects of ribosomal protein mutation on expression of the phagocyte gene and on the bacteria gene. It has been found that the same ribosomal protein mutation would have different effects on different genes or gene groups. The effects on the same gene or gene group due to different ribosomal protein mutations are also different.

This research group recently employed isotope permeation, gene fusion, enzyme detection, protein electrophoresis, DNA probe and other methods in their experiments and have shown that ribosomal protein mutation has no effects on DNA reproduction and ribonucleic acid transcription. Its effect on gene expression takes place only in the translation stage.

Gene Diagnosis of Hemophilia Adopted

90FE0016C Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 15 Feb 90 p 2

[Article by Guo Shangjiong [6753 0006 6608]]

[Text] Hemophilia A is the most commonly seen hereditary disease of the blood system that often occurs in children. The patient will have hemorrhage of the joints or soft tissue and may progress to a total loss of mobility and even death. The occurrence rate of hemophilia is one in every 10,000 for males. To date, there has not been a satisfactory treatment for hemophilia A patients. Since 1986, an in-depth study of the hemophilia gene has been conducted in a joint effort of the Biochemical Research Laboratory of the Basic Medical Research Institute under the Chinese Academy of Medical Sciences, the Beijing Xiehe Hospital, and the University Hospital of the Guangxi Medical School. A complete system of tests for hemophilia A has been developed. The research results contribute greatly toward effective genetic control and prevention of the birth of hemophiliacs.

In recent research on molecular genetics, a DNA genetic diagnosis of hemophilia was conducted in 1984 using multiphase genetic indicators. In 1986, the research group started a systematic study of hemophilia patients

among the Chinese. For the first time, they have analyzed the composition, frequency and multiphase information of the five groups of limiting sections in the genes of the Factor VIII in Chinese hemophiliacs. They have provided data for genetic diagnosis of hemophiliacs in the Chinese group, and they have established a sensitive and economic system for examining the length of the limiting enzyme. They have completed genetic examinations of 12 females from nine hemophilia families to see if they are carriers, and carried out prenatal examinations of 16 high-risk fetuses. Today they are using the polymerase chain reaction (PCR) method for prenatal examinations. The method is valuable for eugenic development and for improving the quality of the populace.

New Role of Macrophage Unveiled

90FE0016B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 15 Feb 90 p 2

[Article by Wang Lianxi [3769 6647 0823]: "China Makes Major Discovery in Human Macrophage Research"]

[Text] Under the supervision of the famous orthopedic expert Professor Ge Baofeng [5514 1405 0023], Senior Technician Bai Menghai [4101 1322 3189] of the Lanzhou Military Region Orthopedic Trauma Research Institute has applied an advanced time-lapse position-register photography technique to reveal that the damage of osteosarcoma caused by the macrophage is due to the toxin of the cells. This conclusion is regarded by experts as a highly significant discovery in basic theoretical medical research.

Macrophage cells are the major immune cells in the human body. They control the growth and transfer of tumors. The traditional view of the mechanism of the macrophage is phagocytosis. Research in this area is still in the animal-experiment stage. Since the beginning of 1988, Bai has been conducting in vitro studies of the role of macrophages on osteosarcoma. The experimental results show that human macrophage cells do not kill the osteosarcoma cells by phagocytosis. Instead, they first make intimate contact with the cell membrane of the sarcoma cells and then release lysosomes through microscopic tubes into the sarcoma cells, thereby deforming, dissolving and killing the tumor cells. This research helps understanding of the mechanism of macrophage cells and provides an experimental basis for advancing immunological treatment of malignant bone tumors to the clinical stage.

Color Ultrasound Blood-Flow Imagery System Developed

90FE0016A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 27 Feb 90 p 1

[Article by Li Xiguang [2621 1585 0342]]

[Text] Beijing, 26 Feb (XINHUA)—Scientists of the Chinese Academy of Sciences (CAS) recently developed

China's first color ultrasound blood-flow imagery system. Experts say that this achievement signals that China has entered the forefront in ultrasonic medical diagnosis and has ended its reliance on imported equipment in this area.

The color ultrasonic blood-flow imagery system is the most advanced clinical diagnostic equipment developed in recent years by ultrasound medical engineering researchers. Because it can nonintrusively diagnose cardiovascular diseases of the human body in real time, this high-tech equipment has become a medical diagnostic tool with great potential for further development.

In the testing and report session held today by the State Science and Technology Commission and the State Pharmaceutical Administration, experts claimed that the color Doppler blood-flow imagery system developed by CAS's Anke [1344 4430] Company has reached or exceeded international standards for similar units in all categories; it has written a new page in China's history of medical imagery technology.

Experts predict that from now on, China will annually produce at least 110 units of such large-scale medical equipment, with 50 units serving domestic hospitals and 60 units targeted for the international market.

It was learned that, besides China, only the United States, Japan, and the FRG are capable of producing such high-tech systems. There are only a few thousand hospitals in the world that are equipped with such a system, and China accounts for 200 of those hospitals.

First Nuclear-Sterile Wheat Mutation Produced

90CF0264D Beijing GUANGMING RIBAO in Chinese 17 Dec 89 p 1

[Article by Liu Lusha [0491 6424 3097]: "Taigu Nuclear-Sterile Wheat Research and Breeding Makes Major Progress"]

[Text] As a result of nearly 10 years of cooperative breakthrough efforts by 44 organizations, major progress in basic theory and breeding practice has been made in connection with the world's first natural-mutation nuclear sterile wheat, the Taigu nuclear-sterile variety, which was discovered by Chinese agrotechnology personnel. Nuclear-sterile crop research in China has already become a well-developed system and has attained a leading position worldwide.

Taigu nuclear-sterile wheat was discovered in 1972 in Taigu County, Shanxi Province, and was evaluated and named in 1979 by Dr Deng Jingyang [6772 2529 2254] of the Chinese Academy of Agricultural Sciences' Crop and Cultivation Institute. Wheat is a self-pollinating crop and the traditional cross-breeding method involved artificial removal of the stamens flower-by-flower, followed by pollination with the flowers of other plants, a procedure that was laborious and time-consuming. The term nuclear-sterile refers to sterility controlled by genes

within the cell: the male organs are sterile, while the female organs are normal and can hybridize and bear fruit, making them an extremely unusual and valuable breeding material.

China set up a national Taigu nuclear-sterile wheat research coordination group in 1981. The group made a comprehensive study of Taigu nuclear-sterile wheat, ranging from its flowering characteristics to microscopic changes in the metabolism of proteins, nucleic acids and enzymes, in which they made major theoretical breakthroughs. In the past, there was disagreement among geneticists as to whether nuclear-male-sterile plants existed. By means of genetic analysis, Deng Jingyang proved that this wheat's sterility is controlled by a gene that expresses male sterility; he also designed a set of gene-sequencing programs in which he determined the location of the sterile gene in the chromosomes and demonstrated that the plants' nuclear male sterility was genetically controlled. The impetus of this result led to China's discovery of dominant nuclear-sterile millet, flax and paddy rice and light-sensitive recessive nuclear-sterile paddy rice.

Deng Jingyang suggested that the nuclear-sterile gene be used for recurrent selective breeding of self-pollinating plants so as to make full use of the wheat gene pool, including the major gene and the immense number of minor gene groups; this is something that was very difficult to achieve either by traditional breeding methods or by modern gene engineering. When this theory was put forward last year at the 7th International Wheat Genetics Conference, it attracted the attention of colleagues throughout the world, who believed that it was likely to help countries break out of the world wheat stagnation of the last 20 years and was thus of major significance.

Large-scale recurrent selective breeding of self-pollinating crops is still unprecedented worldwide. China's scientific and technical personnel used Taigu nuclear-sterile wheat for recurrent breeding, obtaining substantial results, and were able to breed a group of high-output, superior-quality, disease-resistance, lodging-resistant strains, 40 of which are undergoing national, province-level, municipality-level and district-level testing; this year they were sown on an area of 500,000 mu.

Biosensor R&D Reviewed

90CF0264C Shanghai JIEFANG RIBAO in Chinese
10 Nov 89 p 6

[Article by Hu Jun [5170 6511], Shanghai City Industrial Microbiology Research Institute: "Actively Develop New Biosensors"]

[Text] Biosensors are different from physical and chemical sensors that detect light, sound, pressure, temperature, gases and ions; being based on biological components and making use of biochemical and

electrochemical reaction principles to convert biochemical signals into electrical signals, they are used in new analytical systems to detect substances. Because these systems have the capability of distinguishing between molecules, are amenable to electrochemical amplification and can realize reagent-free analysis, they have had a major effect in clinical diagnosis, industrial fermentation control, food sanitation, environmental monitoring, and defense, and they have great development potential.

In the last few years, biosensor research in China has been making great strides. Several dozen universities and research institutes in the country now have specialized research units or are planning to introduce a suitable proportion of research topics, but China is still very far behind world biosensor research and development. Total sales on the U.S. biosensor market totaled \$29 million in 1987 and \$62 million in 1988; this year [1989] it is estimated that they will be \$150 million. The figures for Japan and Europe are even more imposing. But most research in this field in China is still in the laboratory stage, and there is no way to convert it into products. In Shanghai, the research departments and units are spread out among the advanced schools, research and factory enterprises; personnel are dispersed; coordination is difficult; and there are cases of duplication of research. Calculations based on biosensor research reports indicate that although the field has been in existence for more than 10 years in China, no full-fledged product has yet emerged. The few existing equipment models suffer from such problems as crude appearance, limited variety, and poor competitiveness.

Efforts are being made abroad to develop second-generation biosensors and such products have already appeared on the market. In these biosensors, biological oxidation and electrochemical theory have been used to revamp the traditional biosensor model with an oxygen electrode as the basic sensor head, replacing it with conductive micromolecular organic compounds that function as electron carriers in biological redox reactions. Our institute has taken the first steps in mastering the principles and fabrication of this type of biosensor. But in our attempts to carry on intermediate testing and put it into production, we are experiencing very great difficulties in terms of funds, materials and equipment. Shanghai has a definite technological basis and research capabilities in immobilization technology, transducers and secondary instrumentation and is quite capable of integrating these fields, carrying on overall planning and setting the development of this high-technology industry in motion. I suggest that the municipal science and technology leadership departments unify the program, coordinate biosensor research and development, determine and compare the current states of research at all organizations and their directions of research, and rationally adjust funding allocation methods. Expert evaluation should avoid particularism and subjective views. The funds-allocation system must guard against ranking organizations by wealth and must lean toward fresh research topics that have production potential and are

competitive and can keep up with foreign high-technology development capabilities, so that the limited research funds produce a real effect.

New Strategy for Pharmaceutical Industry Laid Out

90CF0264A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 17 Dec 89 p 1

[Article by Jia Xiaohui [6328 2556 1979] and Tang Shifen [0781 1102 5358]: "Develop Biotechnology, Implement the Strategic Changeover"]

[Text] The State Pharmaceutical Administration recently stated that in order to implement the state program for the development of biotechnology, it will devote a major effort to the strategic changeover from a primary focus on chemistry to a primary focus on biotechnology. A pharmaceutical biotechnology expert committee has been set up and has begun work.

Biotechnology will be a focal area of world high-technology development in the next century; about 70 percent of international biotechnology research will be in the pharmaceuticals field. China attaches full importance to developing biotechnology. The "High-Technology Research and Development Plan" drafted by the State Planning Commission and the State Science and Technology Commission has placed biotechnology at the head of the seven high-technology focal development areas.

In 40 years of arduous struggle, China's pharmaceutical industry has attained a respectable scale and has provided the people with large amounts of drugs for treatment and prevention. But in overall terms, our pharmaceuticals essentially remains a traditional industry with traditional products, based primarily on chemistry; if we wish to make continued progress and to narrow the gap that separates China from the world state-of-the-art, we must develop pharmaceutical biotechnology: this is a key strategic task for the pharmaceutical industry.

In order to China's pharmaceutical industry to develop biotechnology, the first order of business is to intensify biotechnology research and development for new pharmaceutical products. Biotechnology can greatly expand limited biological resources, produce them and utilize them to bring benefits to mankind. For example, under traditional methods, the human growth hormone needed by a sufferer from dwarfism would have to be isolated from the pituitaries of 60 cadavers; but by using biotechnology and incorporating the gene into *Escherichia coli*, the needed hormone can be obtained from a few dozen milliliters of fermentation liquid. Hope for treatment or immunization for certain hard-to-defeat, pernicious diseases such as cancer, cardiovascular disease and the like is also offered by biotechnology.

Using modern biotechnology to modernize traditional pharmaceutical production is another major order of

business for China's pharmaceutical industry. The application of such modern biotechnologies as gene engineering, cell engineering and enzyme engineering to the production of antibiotics, amino acids, vitamins and similar chemical pharmaceutical materials offers the prospect of high-efficiency, low-energy-consumption, superior-quality, low-waste production. Paracetamol produced by biotechnology costs one-third less than that produced by chemical synthesis. Of 82 biotechnology pharmaceuticals now being developed in the United States, China has the technological capabilities to pursue the development of 65. Experts estimate that China's level of research in this field is only 3 to 5 years behind the world state-of-the-art, while its production and applications technologies are 10 to 15 years behind. Industrializing biotechnology is a major matter that will determine whether China's pharmaceutical industry will advance or fall behind in the next century.

Experts state that the development of pharmaceutical biotechnology in China must start with its industrialization. If we can establish a highly favorable situation in pharmaceuticals biotechnology in the next 3 to 5 years, concentrate investments and technological manpower, establish key laboratories, research and development centers and production bases centered on the development of new products, and establish the relevant production technology support industries, there is a possibility of developing a group of new biotechnology products for the market during the final years of the century and moving out into the wider world.

Pure Human Gamma-Interferon To Be Marketed in 1991

90CF0264F Beijing GUANGMING RIBAO in Chinese 24 Dec 89 p 1

[Article by Zhang Xuequan [1728 1331 0356]: "Chinese Human Gamma-Interferon Gene Research Achieves Results"]

[Text] Shanghai, 23 Dec (XINHUA)—Recent human (gamma) interferon genetic engineering research carried out by Chinese scientists has established the international state-of-the-art by achieving a laboratory yield far higher than comparable foreign results.

Because it has a greater output than the use of natural induction and a much lower production cost, the use of gene engineering to synthesize human (gamma) interferon is a popular research topic throughout the world. Such countries as the United States and Japan are competing vigorously in this field. But the expression rates obtained by them are only 30 to 40 percent of total microbial protein, while China has now achieved a rate of over 60 percent. This creates favorable conditions for transference of the research results to industrial production and for the attainment of high efficiency.

This research, begun in 1986, was a cooperative effort of the Shanghai Biochemical Institute of the Chinese Academy of Sciences [CAS], the Fudan University

Genetics Institute, and the Second Army Medical University's Biotechnology and Molecular Genetics Research Institute.

This result passed its expert evaluation yesterday. Knowledgeable persons told a reporter that it will rapidly be put into intermediate trial development, and it is estimated that after a year the product may be on the market.

Type 71 Enterovirus Isolated

90CF0264B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 1 Dec 89 p 2

[Article by Liu Xueduo [0491 1331 6995]: "China Isolates Type 71 Enterovirus for the First Time"]

[Text] Young scientific and technical personnel of the Hubei Medical Academy's virus research institute Zheng Zhiming [6774 1807 2494], Zhang Jianghong [1728 3068 5725] and Zhu Weiping [6175 5898 1627] recently isolated a virus from the vesicular fluid of a hoof-and-mouth disease case which was identified by serological analysis as type 71 enterovirus; experts believe that this is the first time that this virus has been found in China.

Hoof-and-mouth disease is an infectious viral disease, the first epidemic of which in China was identified in Shanghai in 1980; thereafter, epidemics also occurred in Hebei, Shandong, Beijing and Tianjin. Pathologists have found that Cox A16 virus was the source of the cases of hoof-and-mouth disease in China. There have been reports of the isolation of enterovirus 71 abroad, but during the outbreaks of hoof-and-mouth disease in China in the last 9 years there has been no report of isolation of the virus, and there are no reports of other diseases caused by enterovirus 71. When Assistant Professor Zheng Zhiming and his group first isolated the virus, they filled in a blank spot. The virus can grow and reproduce in primary human embryo lung cells, MA104 cells, and BSC cells. It also induces typical morbid cellular changes, and when administered to suckling mice it may produce paralysis and death. Under the electron microscope, the cytoplasm of cells infected by the virus is seen to contain large numbers of crystallized mature virus granules about 25 nm [as published] in diameter; the patient's two serum fractions show a four-fold increase in neutralizing antibodies against this virus. Further results obtained by Zheng Zhiming and his coworkers indicate that the enterovirus 71 that they isolated has common antigens with the Cox A16 virus.

Enterovirus 71 can produce encephalitis, meningitis, hoof-and-mouth disease, and poliomyelitis-like disease. The hoof-and-mouth disease that it produces is accompanied by central nervous system symptoms in 10 to 24 percent of cases, and consequently, defending against infection by it is extremely important.

First Cell-Engineered Cotton Plant Developed

90CF0264E Beijing GUANGMING RIBAO in Chinese 21 Dec 89 p 1

[Article by Yu Yunda [5713 0061 6671] and Lu Liang [4151 5328]: "China Successful in Protoplast Propagation of Cotton"]

[Text] Hangzhou, 20 Dec (XINHUA)—It was learned today at the cotton protoplast propagation evaluation meeting held by the Ministry of Agriculture in Hangzhou that China had recently been successful in protoplast propagation of cotton. The evaluation committee of eight noted specialists, headed by Professor Jian Yuyu [4675 3768 3842], concluded that this research result was a first at the national level and indicates that China's research in cotton cell engineering technology had reached the world state-of-the-art.

Cotton protoplast propagation research is a subtopic of the key research topic "Major Crop Propagation and Cell Fusion Technology" under the Ministry of Agriculture's Seventh 5-Year Plan. Since 1985, China has had success in the protoplast propagation of paddy rice, soybeans, corn, wheat, millet and sorghum. Because cotton differentiates poorly and has relatively few genotypes, its protoplast propagation has long been a difficult problem of world plant engineering research. In 1987, the Ministry of Agriculture took the lead in organizing a joint breakthrough project of the Jiangsu Agricultural Science Academy's Genetics and Physiology Institute and the Shanxi Agricultural Science Academy's Cotton Institute, in which associate research fellow Chen Zhixian [7115 1807 6343] and assistant research fellow She Jianming [0152 1696 2494] worked steadily on this topic together. Thirteen research units and major academies and specialized schools, including the South China Agricultural University, demonstrated a spirit of large-scale socialist cooperation and gave this research activity their unrestrained support. Chen Zhixian, She Jianming and the others worked hard for 2 years, and finally, in July and August of 1989, they obtained several regenerated plants from cultivated upland cotton varieties Ke Nos 312 and 201, Jinmian No 4, and Jiangsu 3118, completing their contract assignments a year ahead of schedule.

Protoplast regeneration uses the propagation of cells with their cell walls removed to produce regenerated plants. Because the protoplast has no cell wall, it is possible to carry out trans-species crosses, to transfer biologically useful genes into receiver plants, and to create new types of plants at will. The specialists excitedly told a reporter that the success of cotton protoplast propagation provided a brand-new technological route for China to carry out cell fusion, gene induction and other biological technologies in order to create and breed high-yield, superior-quality new varieties, and thus was of great value.

PreS2-HBsAg Expressed in E. coli as Membrane Protein Component

40091012D Beijing ZHONGHUA

WEISHENGWUXUE HE MIANYIXUE ZAZHI
[CHINESE JOURNAL OF MICROBIOLOGY AND
IMMUNOLOGY] in Chinese Vol 10 No 2, Apr 90
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[English abstract of article by Duan Lingxun [3008 7117 3410], Wu Guanghui [6762 0342 1920], et al., Laboratory of molecular biology, Institute of Hepatology, Beijing Army General Hospital]

[Text] In order to study the factors affecting the expressions of HBsAg in E. coli, we have fused PreS2-HBs structure gene from adw2 HBV-DNA to the pIN-IIc vector plasmid carrying the DNA sequence coding for lpp signal peptide plus eight amino acid residues and designated this construction pH4. The recombinant plasmid is under transcriptional control of the tender lipoprotein promoter, lactose promoter-operator and is regulated by the lactose repressor. In the presence of inducer, cells were harvested, and after disruption by sonication and centrifugation, the pellet was treated with 8M urea and Triton X100. Further purification by gel filtration and DEAE-cellulose chromatography was carried out. The HBsAg activity in the pooled fraction was assayed by RIA. The results showed that the quantity of the polypeptide with HBsAg activity in membrane fraction was 1500 times of that in cytoplasmic fraction. The MW of the recombinant HBsAg was determined to be 35kD and 26kD by SDS-PAGE. By using monoclonal anti-HBs indirect immunofluorescence and colloid gold labelling it was demonstrated that the polypeptide was assembled into the outer membrane of E. coli. The characteristic of this expressed polypeptide was studied and is discussed in this paper.

Key words: PreS2-HBsAg; Gene cloning and expression; Transmembrane protein

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Analysis of the Hybrid Strain Containing Genes Coding O Antigen of V. cholerae LPS and Study on Its Protective Effect40091012A Beijing ZHONGHUA WEISHENGWUXUE
HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF
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[English abstract of article by Zhang Shubo [1728 2885 3134], Zhang Jizhong [1728 4949 1813], et al., Institute of Epidemiology and Microbiology, Chinese Academy of Preventive Medicine, Beijing]

[Text] The cosmid banks were constructed with chromosomal DNA of V. cholerae 79005 (Ogawa). The vector used was pH79. The cosmid clones were expressed in E. coli K-12 DH1 strain. Screening the cosmid banks by colony blotting with McAb of anti-V.c LPS A, a strongly positive-reacting colony p795-1 was obtained. With the agglutination test and Western blot assay, it was demonstrated that p795-1 contained genes coding antigens A and B of V. cholerae LPS. They were expressed in E. coli K12 DH1 in the same degree as in V. cholerae 79005. Vibriocidal assay and sucklingmouse protection assay have been used for analysis of the protective activity of p795-1. The results showed that when DH1 harboring plasmid p795-1 was used for immunogen, its protection rate was about the same as the immunogen of Ogawa or Inaba serotype of V. cholerae.

Key words: Vibrio cholerae; O antigen; Gene cloning; Protective effect; LPS (Lipopoly saccharide)

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Use of Transposon Tn501 in Construction of Bivalent Vaccine Strain of Dysentery Bacillus

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WEIZHENGWUXUE HE MIANYIXUE ZAZHI
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[English abstract of article by Mu Zhaoqin [3664 0340 2953], Xing Li [6717 7787] and Mao Peiji [3029 1014 1015], Institute of Microbiology and Epidemiology, Academy of Military Medical Sciences, Beijing]

[Text] Transposon Tn501 is Hg-resistant. The pMT999 carrying Tn501 (Hgr) was integrated into form I plasmid (pSS120) of S. sonnei by conjugal transfer, so that form I plasmid obtained Hg-resistibility. The cointegration plasmid was co-transferred into S. flexneri 2a T32 vaccine by conjugation. The bivalent hybrid strain of S. flexneri 2a and S. sonnei, FSM21-17, was constructed. The FSM21-17 strain expressed O antigens of both S. flexneri 2a and S. sonnei. It is an avirulent and stable hybrid strain. It possesses bivalent imm nogenicity in rabbits and bivalent protective effect in mice.

Key words: Transposon Tn501; Bivalent vaccine strain of dysentery bacillus

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Isolation of Bdellovibrio Bacteriovorus From Human Stool

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WEISHENGWUXUE HE MIANYIXUE ZAZHI
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[English abstract of article by Hu Lan [0729 5695] and Liu Bingyang [0491 4426 7122], Institute of Epidemiology and Microbiology, Chinese Academy of Preventive Medical Sciences, Beijing]

[Text] Bdellovibrio bacteriovorus(Bd.b) is a unique gram-negative bacteria living on other bacteria. They were isolated from aquatic and terrestrial intestinal ecosystems, but have not yet been successfully isolated from human being by previous workers. With tap water double-layer agar medium, we have successfully isolated 8 strains of Bd.b out of 86 stool samples from Beijing youngsters. Checking up with plaque characteristics, Gram stain, phase and electron microscopy, the strains which we isolated were found to possess typical biological characteristics of Bd.b.

We defined their optimal cultural conditions. The optimal growth was achieved at 37°C, pH7.0, in aerobic or microaerophilic environment. Our strains behaved as parasitic and bacteriolytic and is able to lyse a variety of gram-negative bacteria (including Shigella, E. coli, S. typhimurium and V. cholerae) under facultative aerobic condition, and B.fragilis under micro-aerophilic condition. Infected with a simple coréal test in guinea-pig was used to evaluate their protective effect on experimental animals. We found that the human intestinal strain of Bd.b could prevent the animal from experimental infection with pathogenic Shigella flexneri 2a.

Key words: Bdellovibrio bacteriovorus, Isolation; Human stool

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Cytopathic Effect of 76-118 Strain of HFRS Virus on Vero Cells

40091012E Beijing ZHONGHUA WEIZHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 10 No 2, Apr 90 pp 109-112

[English abstract of article by Nie Zilin [5119 1311 2651] and Yu Yongxin [0205 3057 2450], National Institute for the Control of Pharmaceutical and Biological Products, Beijing]

[Text] Vero cell line, the parent of Vero-E6 cells, is also sensitive to viruses of hemorrhagic fever with renal syndrome. HFRS viruses, especially 76-118 strain, can replicate with high titer and cause a typical cytopathic effect (CPE) on Vero cells. Vero cells began to change their morphology and fuse together on day 4 after infection with 76-118 strain of HFRS virus. The CPE can be reduced by neutralization of the viruses with rabbits anti-HFRS virus sera and HFRS patient's convalescent sera.

The infective titer tested by CPE was as high as that by immunofluorescence (IF) assay, but was lower than that by plaque assay. This is the first time to demonstrate the presence of viruses of CPE on Vero cells infected with HFRS virus. The application of these characteristics of HFRS viruses needs to be further studied.

Key words: Hemorrhagic fever with renal syndrome (HFRS) virus; Vero cell line; Cytopathic effect (CPE)

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Detection of HFRSV Antigens in PBMC From HFRS Patients and Study of Their Distribution in Lymphocyte Subsets

40091012F Beijing ZHONGHUA WEIZHENGWUXUE HE MIANYIXUE ZAZHI [CHINESE JOURNAL OF MICROBIOLOGY AND IMMUNOLOGY] in Chinese Vol 10 No 2, Apr 90 pp 113-115

[English abstract of article by Huang Chuanshu [7806 0278 2579], Jin Boquan [6855 0130 3123], et al., Department of Immunology, The Fourth Military Medical University, Xi'an]

[Text] This paper reports detection of HFRSV antigen in peripheral blood mononuclear cell (PBMC) by McAbs (3G1 and 5H5) against HFRSV with APAAP technique. The distribution of HFRSV antigen positive cells in lymphocyte subsets was also studied with ABC and APAAP double staining. The results indicated: (1) The positive percentages of HFRSV antigen in PBMC from acute phase and convalescent phase patients were 25.5 plus over minus 2.5 percent and 7.6 plus over minus 2.1 percent respectively. (2) Subsets of HFRSV positive PBMC from acute phase patients included T4, T8, B1 and MKH1 lymphocytes and their positive percentages were 34.8 plus over minus 2.8 percent, 29.2 plus over

minus 2.5 percent, 18.5 plus over minus 2.7 percent and 9.1 plus over minus 2.3 percent respectively.

Key words: HFRS, HFRSV; APAAP technique; Lymphocyte subsets

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Poliovirus Separation by Centrifugation in Percoll Isopycnic Gradients

40091012G Beijing ZHONGGUO YIXUE KEXUEYUAN XUEBAO [ACTA ACADEMIAE MEDICINAE SINICA] in Chinese Vol 12 No 2, Apr 90 pp 142-145

[English abstract of article by Zhang Jianewen, et al., Institute of Medical Biology, Kunming]

[Text] Centrifugation in Percoll isopycnic gradients is reported as effective and simple method for separation and purification of polioviruses. By this method, not only may one separate poliovirus from simian virus 40

(SV40), but also may separate empty virions from solid virions of poliovirus. The bouyant density in Percoll of solid virion of poliovirus, empty virion of poliovirus and SV40 are 1.084, 1.051 and 1.13, respectively. The recovery rate of virus is about 65 percent.

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Biological Characteristics, Relationship Between Antigen and Serology of Tupaia Adenoviruses (Type I and II)

40091012H Beijing ZHONGGUO YIXUE KEXUEYUAN XUEBAO [ACTA ACADEMIAE MEDICINAE SINICA] in Chinese Vol 12 No 2, Apr 20 pp 113-115

[English abstract of article by Wu Xiaoxian [0702 1420 7033], Tu Xinming [3205 2450 2494], et al., Institute of Laboratory Animal Science]

[Text] The strains of adenovirus were isolated from pharyngeal swabs, kidney cell culture; and stool of tupaia (tree shrew). They were identified by a series tests of biological characteristics and electron microscopy studies. Ten strains of tupaia adenoviruses (TAV) may be divided into two serum types: termed TAV-I and TAV-II. There was no cross-reactivity of neutralization antibody between TAV-I and TAV-II, except a slight cross-reactivity in the complement fixation test. TAV-I could hemagglutinate R.B.C. of rat, mouse, human 'O' type, and tupaia itself in blood was more than 50 percent in natural tupaia population, suggesting of TAV infecting latently in wild tupaia colony.

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Hong Kong-Yunnan To Set Up Biotech Research Center

40101018A Beijing *CHINA DAILY* in English 2 Jun 90 p 3

[Text] Hong Kong (XINHUA)—A draft agreement on the establishment of a Hong Kong-Yunnan biotechnology development centre has been signed here.

This will be the second centre established by the Hong Kong Institute of Biotechnology of the Chinese University of Hong Kong. The first one was the Hong Kong-Shanghai Biotechnology Development Centre set up early this year.

The agreement was signed recently between the Hong Kong institute and the Yunnan Provincial Commission of Science and Technology.

Dominic Man-Kit Lam, director of the Hong Kong institute, said the centre will capitalize on the biotechnological research strengths of the Yunnan Provincial Commission as well as the strategic position of the Hong Kong side in the region in developing and commercializing novel biotechnology products for the world market.

Wuzhou Becomes Largest Export Center for Snakes

40101018B Beijing *CHINA DAILY [BUSINESS WEEKLY]* in English 4 Jun 90 p 2

[Article by Li Zhuoyan]

[Text] Wuzhou has now become China's largest export centre for snakes—and a three-story warehouse in that port city stores more than 500,000 snakes a year.

"Even in the world, such a large big storehouse of snakes is rarely seen," said Gan Yilin, vice-manager of the wild animals and aquatics department of the Wuzhou branch of the China National Cereal, Oils and Foodstuffs Import and Export Corporation.

In 1988, over 300,000 snakes were exported from here to Hong Kong, Macao, Taiwan, South Korea and some Southeast Asian countries, earning foreign exchange of some \$500,000.

And in 1989, about 100,000 snakes were sold abroad, which earned over \$150,000 for the company.

"The snakes we are exporting include six species of poisonous snakes—the cobra, the king cobra, the gold-coiling snake, the silver-coiling snake, the viper, the long-nosed pit viper," said Gan as he played calmly with these lethal creatures.

The branch also exported five kinds of non-poisonous snakes.

Guangxi, Gan explained, with the mild and human sub-tropical climate and hilly geography, is the best place in the country for snakes to breed and live.

And Wuzhou, Guangxi's biggest port city where the three rivers, the Xijiang, the Guijiang and Xunjiang rivers join, has long been the collecting and distributing centre for snakes.

"People here not only make delicious dishes from snakes, but also take them as medicines and use them in many other ways," Gan said. Wandering around Wuzhou, one can find not only many snake dishes, soup and custard served in most of the restaurants, but also snake wines, preserved snake biles and analgesics made from snake venom on sale in many stores.

"Before 1950, snakes were traded mainly by private pedlars. But after liberation, the business has been undertaken mainly by State-owned units," Gan said.

He said about half of the snakes the storehouse purchased were wild snakes. The rest, however, had been

bred artificially. "Now, to breed snakes has become a special trade of many households in Guangxi," Gan added.

After entering the storehouse, the snakes have to remain there for one or two months before they are sold, during which time they mainly live on glucose.

Most of the people breeding snakes are women, according to Gan, and in the storehouse, over 40 out of the 60 workers taking care of the snakes are female.

"Because they are more careful and patient than men, the most important character required in playing with snakes," Gan said.

Status of China's Domestic Commercial Satellite Communications

90FE0151A Beijing DIANXIN JISHU
[TELECOMMUNICATIONS TECHNOLOGY]
in English No 4, Apr 90 pp 6-7

[Article by Liu Shen [0491 3088]]

[Text] China's domestic commercial satellite communications began by renting satellite equipment from other countries and operating initially in the C-band to satisfy basic communications needs. Starting in November 1985, China rented transponders from INTELSAT for long-distance telegraph and telephone communications. Later, it rented (purchased) four 72-MHz, hemispherical-coverage transponders with edge power of 29 dBw for television transmission. In March and December of 1988, two Chinese-built communications satellites were successfully launched, thus providing six additional domestic-coverage transponders with edge power of 31.5 dBw. Today, the television programs being broadcast include two sets of programs developed by the Central Television Station and four programs developed by local TV stations; plans are also underway to develop an educational station by transcribing two programs from INTELSAT to the transponders on domestic satellites. China also has more than 15,000 television receiver-only [TVRO] stations. As of early 1990, there are approximately 1,500 public circuits and 160 dedicated circuits (one-way channels) for telegraph, telephone and data communications, and 30 channels of satellite-broadcast TV programs; in addition, dozens of low-data-rate TDM/SCPC VSAT's [time-division multiplexing/single channel per carrier very-small-aperture terminal] are also in operation. By mid-1990, a number of TDM/TDMA [time division multiple access] VSATs will begin operation. In this article, the current status of China's domestic satellite communications system—which has already begun to take shape—is summarized.

1. Television Transmission

The high-power downlink transponder used on domestic satellites can operate with relatively large frequency deviations; an increase of peak-to-peak frequency deviation ΔF_{p-p} from 16.8 MHz to 21.1 MHz will increase the S/N [signal-to-noise ratio] by 2 dB. The increased S/N provides very good reception for a TV receiving station with a 6-m antenna; a 4.5-m antenna receiving station can achieve an S/N greater than 45 dB (with uniform weighting); even a 3-m antenna receiving station can achieve medium-quality reception. However, in areas where the satellite EIRP [effective isotropic radiated power] is low, one may see flickering spots on the TV screen because of the low C/N [carrier-to-noise ratio] and the large frequency deviation. Generally speaking, by using a ΔF_{p-p} of 21.1 MHz, TV transmission is 4 dB higher in S/N on domestic satellites than on international satellites.

At the request of the Ministry of Radio, Film and Television, tests will be conducted to improve the

quality of conventional TV transmission by using the PAL-MAC-PAL mode of transmission (D_2 -MAC). In addition, there are four digital channels which can be used for sound accompaniment and radio broadcast.

2. Long-Distance Telephone (Public Network)

(1) The main trunklines linking the provincial capitals and large cities use the conventional FDM/FM/FDMA [frequency-division multiplexing/frequency modulation/frequency-division multiple access] mode of transmission. This is the primary mode used by this country for international satellite communications; most equipment used for this mode of transmission can be produced domestically.

(2) In the area of digitization, tests have been conducted on the use of 60-Mbps TDMA, 64-kbps digital circuits with a capacity of 800-900 channels, and INTELSAT-compatible IDR/DCME [intermediate data rate/digital channel multiplexing equipment]. The IDR uses a 2-Mbit, 30-channel, 64-kbps carrier circuit, and provides 120 voice channels by applying DSI [digital speech interpolation] technology with DCME and by using reduced-speed (32-kbit) ADPCM [adaptive differential pulse code modulation].

(3) The use of SCPC/CVSD [continuously variable slope delta modulation] will be gradually phased out in high-traffic regions such as provincial capitals and large cities; they will be limited to light-traffic, intra-provincial networks. The larger intra-provincial networks still use the high-capacity FDM/FM/FDMA mode of satellite transmission.

3. VSAT Communications

By early 1990, China will have three different types of C-band VSAT systems in operation. They are representative of the different designs of VSAT systems used by other countries.

(1) The TDM/SSMA (spread-spectrum multiple access) mode. The one-way system is called the Data-News-Transmission system, also called INTELNET-I; the two-way system is called INTELNET-II. China's XINHUA Press Agency uses the one-way system. This design requires more equipment in the main station, but small antennas in the branch stations (1.8m x 1.2m for two-way transmission and 0.6m for one-way transmission). The spread-spectrum design requires a wide bandwidth, but it provides good security and has strong interference-rejection capability. Its main disadvantage is that any frequency conversion would require changing the crystal, which is very cumbersome. The transmission rate generally lies between 1.2 kbps and 2.4 kbps; in some cases it can reach 9.6 kbps.

The outbound carrier (i.e., the carrier transmitted from the main station to the branch stations) has an information transmission rate of 76.8 kbps for two-way transmission and 19.2 kbps for one-way transmission. It uses

BPSK [biphase shift keying] modulation, $\frac{1}{2}$ FEC [forward error correction] and pseudo-random code spread spectrum (16 positions per bit for two-way transmission and 64 positions per bit for one-way transmission; each occupies a 5-MHz bandwidth). The data flow of the carrier after spread spectrum processing is 2.4576 Mbps.

The inbound carrier (i.e., the carrier transmitted from the branch stations to the main station) has a typical transmission rate of 1.2 kbps; it is BPSK modulated with $\frac{1}{2}$ FEC, and uses 1024-bit pseudo-random code spread spectrum. The transmitted data flow is also 2.4576 Mbps and occupies a 5-MHz bandwidth. The same 5-MHz bandwidth can be shared by hundreds of branch stations without mutual interferences; they are separated by the main station according to their unique pseudo-random codes.

(2) The TDM/SCPC [single channel per carrier] mode. The outbound carrier is also TDM processed and can have spread-spectrum transmission. It has been used by some of China's high-traffic stations with favorable results. The outbound carrier has an information transmission rate of 57.6 kbps and occupies a bandwidth of 350 KHz; the inbound carrier, which is provided for each VSAT, has a typical transmission rate ranging from 1.2/2.4 kbps to 9.6 kbps, and occupies a 14.4-KHz bandwidth. Since each VSAT user occupies a fixed carrier whether it is in use or not, he effectively has a dedicated leased circuit. This design is primarily suitable for use in the Ku band (China uses the C band).

The TDM/SCPC mode uses a 2.5-3.0-m antenna with rather poor interference-rejection capability. Its operation is inconvenient in terms of VSAT address selection and frequency conversion.

(3) The TDM/TDMA (time-division multiple access) design. This is a new system developed in the 1980's. The main station has relatively few pieces of terminal equipment and its functions are mainly performed by software; the unit system can accommodate approximately 3,000 VSAT operations. The system can operate in both Ku band and C band; however, in C band it is susceptible to ground interference. Its frequency conversion, which is accomplished by main-station control and by the VSAT frequency synthesizer, is unaffected by interference. This advanced VSAT system can be used to form a dedicated VSAT network or a public network.

The outbound TDM carrier has an information transmission rate of 512 kbps; with $\frac{1}{2}$ FEC, the transmission rate is 1024 kbps, and occupies a 1.1674 KHz bandwidth; and the allocated bandwidth is 1.6 MHz. The inbound TDMA carrier has a transmission rate of 128 kbps; with $\frac{1}{2}$ FEC the transmission rate is 256 kbps and occupies a 291.8-KHz bandwidth; and the allocated bandwidth of 400 KHz can accommodate a small number of medium-quality 16-kbps telephone transmissions. Each outbound carrier can be linked to 31 TDMA inbound carriers. Adding a dedicated outbound carrier

to the above voice channel provides 13 equivalent two-way satellite voice channels which can be allocated according to user needs. The main control station has the software capability to schedule the users in each inbound carrier according to traffic load conditions, thereby changing the user composition of the inbound carriers.

Actual operational experience in China's domestic satellite communications system over the past 5 years has demonstrated its unique features in terms of development efficiency, transmission quality, flexibility, and low cost. The system is particularly suited for long-distance direct communications, broadcast communications, and user-oriented communications. Because of China's vast territory, it is difficult to establish ground communications over the remote regions; the application of satellite communications not only is more economical, but also provides the required capacity and promotes economic development for these regions.

Japan May Transfer High-Tech

40100058 Beijing CHINA DAILY (BUSINESS WEEKLY) in English 11 Jun 90 p 3

[Article by Xu Yuanchao, staff reporter]

[Text] Economic relations between China and Japan should no longer remain at the level of two-way trade but should enter into the stage of "active technical co-operation."

This was the message from Yasusada Kitahara, science and technology advisor to Japanese Prime Minister Toshiki Kaifu, who said such a move was vital to China's modernization drive in the field of posts and telecommunications.

He was speaking on Wednesday at a meeting with Yang Taifang, Minister of Posts and Telecommunications in China.

Kitahara, a member of the Japan Council for Science and Technology, is heading a Japanese delegation of 17 companies which are taking part in the International Exhibition of Postal and Telecommunications China '90.

The exhibition is scheduled to close in Beijing on Sunday.

After his talk with Yang, Kitahara told CHINA DAILY that Japan would offer "essential technology and expertise" to help modernize China's telecommunications.

The co-operation would start with co-production of programme controlled switches and optical fibre transmission lines using Japanese technology, he said.

"We want to show our latest technology and newest products to the Chinese during the exhibition, and tell them that they don't need to get wrapped up in research using outdated technology."

"We would rather provide the Chinese with technology than sell them our products. This will make China more independent in producing telecommunications equipment."

"It is one of the major reasons why we came to the exhibition," Kitahara said.

He declined to disclose details of his talk with Yang but said it chiefly centred on discussion of the latest Japanese technology which China could use to modernize its telecommunications systems.

They also discussed some preliminary plans to be carried out in China in the years ahead, he said.

"It would be very difficult otherwise for China to realize its modernization drive in telecommunications because of its large population of 1.1 billion and its vast area of land," Kitahara said.

He said he had proposed to Yang Taifang the setting up of a system of telephone bonds in China.

He criticized China's normal practice of borrowing money from one country to construct its telephone systems and importing equipment from another.

China should raise funds by issuing bonds among local applicants for telephones, he said.

"I told Minister Yang that they could use the money to build telephone networks and then repay the money to the people some years later," he said.

His suggestion, which is believed to have been practised successfully in Japan for some years, attracted great attention from Chinese experts when he gave a lecture to 150 of them on Tuesday.

Japanese firms attending the week-long exhibition have included such leading companies as Nippon Electric Corporation (NEC), Nippon Telegraph and Telephone Corporation (NTT), Fujitsu Ltd, Sumitomo Electric Industries Ltd and Oki Electric Industry Company Ltd.

Most exhibits in the Japanese Pavilion were fax machines and video telephones. Japanese officials say those are the products China needs to develop in the 1990s.

One official said Japan saw China as a big market for its fax machines because 70 percent of such machines now in use in China had been imported from Japan.

According to Kitahara, only five per cent of the Japanese exhibits on show would go on sale in China after the exhibition. Most of these would be fax machines.

Osamu Watanabe, chief representative of NEC's Beijing office, said his company did not intend to sell its exhibits to China. They would be shipped to Hong Kong and Japan after the show.

Experts attributed Japan's unwillingness to sell its goods because of Cocom regulations which state that Japan is not allowed to sell high technology and related products to Communist countries.

Status of Uranium Enrichment and Isotope Separation Discussed

90FE0069A Beijing HE HUAXUE YU FANGSHE
HUAXUE [JOURNAL OF NUCLEAR AND
RADIOCHEMISTRY] in Chinese Vol 12 No 1, Feb 90
(MS received 10 Apr 89, revised 5 Oct 89) pp 17-25, 8

[Article by Xiao Xiaolan [5135 0876 1658] of Chinese Institute of Atomic Energy, Beijing: "Status and Prospect of Isotope Separation (I)"]

[Excerpts] [Passage omitted] IV. China's Uranium Enrichment Industry⁴⁶

As early as 1964, China successfully enriched uranium by gaseous diffusion to produce an atomic weapon. From then until the 1970's, efforts were made to improve the gaseous diffusion technique, primarily by increasing the flow of the unit, using a new separation membrane, and enhancing the efficiency of cascade processing. As a result, the production capacity increased several fold. In addition, several gaseous diffusion separation membranes were developed to drastically reduce production costs. Physical and chemical characteristics of these separation membranes were studied in detail. Separation efficiency was raised, the raw-material production technique was improved, and the structure of the separation membrane was changed. As a result, highly efficient, corrosion-resistant, vibration-resistant, long-life separation membranes were developed with quality approaching or meeting world-class level. In the 1980's, a plan was implemented to improve the diffusion cascade. High-performance diffusion units were put into production. Efforts to improve diffusion separation membranes were strengthened. In the meantime, a well-trained uranium enrichment technical team was established.

It has been over 30 years since China began research on uranium enrichment. In the mid 70's, research on the centrifuge method was strengthened. Various aspects related to the gas centrifuge were studied and considerable results have been obtained. This technology is in the process of being industrialized.

Chemical uranium enrichment research began in 1958 in China. Since the 70's, research on uranium isotope separation by electrodialysis with an ion-exchange membrane and ion-exchange resin was performed at Tianjin Institute of Chemistry and Engineering, Beijing Institute of Uranium-Ore Processing and the China Institute of Atomic Energy. In the mid 80's, significant progress was made on ion-exchange chromatography between uranium IV and VI at China Institute of Atomic Energy, resulting in a separation index of greater than 1.001, column plate height of less than 1 mm, and equilibrium time of a few seconds⁴⁷. In a small cascade column, the discharge rate is 40 cm/h. China Institute of Atomic Energy also conducted a study on uranium separation in the invariant-valence-state crown ether system. Preliminary result showed that a single-stage separation index

could be as high as 1.0007 - 1.0001. For such systems, this is the highest number obtained to date^{48, 49}.

In the early 70's, China began to do research on laser separation of uranium isotopes. Initially, the effort was concentrated on molecular laser [MLIS] techniques. A laser separation experiment was conducted in 1976 using sulfur hexafluoride as the simulated medium and separation of ³²S and ³⁴S was realized. In addition, fundamental studies were done on uranium hexafluoride with a TEA [transversely excited atmospheric pressure] CO₂ laser and a carbon tetrafluoride laser. In the early 1980's, atomic laser separation studies—including theoretical analysis, spectral measurement, laser development and separation experiments—were initiated. A uranium isotope separation demonstration experiment was done in 1985 and a relatively high separation index was obtained.

Currently, China still relies upon gaseous diffusion to produce enriched uranium. Since 1981, low-grade enriched uranium has been available for export. Molecular laser and chemical methods are still in the basic-research stage.

[Passage omitted]

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[Passage omitted]

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[Passage omitted]

Fission Product ¹⁴⁹Sm Determination by Isotope Dilution Mass Spectrometry

90FE0069B Beijing HE HUAXUE YU FANGSHE
HUAXUE [JOURNAL OF NUCLEAR AND
RADIOCHEMISTRY] in Chinese Vol 12 No 1, Feb 90
(MS received 17 Aug 88, revised 11 Nov 88) pp 56-58, 39

[Article by Li Silin [2621 1835 2651] and Zhao Motian [6329 1075 3944] of Chinese Institute of Atomic Energy, Beijing: "Determination of Fission Product ¹⁴⁹Sm in Irradiated Power-Reactor Fuel Elements by Isotope Dilution Mass Spectrometry"]

[Text] Key Words: Isotope Dilution, Mass Spectrometry, Sm

I. Introduction

Once nuclear fuel is exposed in a reactor, a series of fission products is produced. ^{149}Sm is a nuclide among the fission products. It has a large neutron reaction cross-section. When it is present in large quantity, the utilization of neutrons is seriously impacted. Therefore, the determination of ^{149}Sm is important to the design and operation of the reactor and the post-treatment of spent fuel.

In this work, isotope dilution mass spectrometry^{1, 2} is used to determine the cumulative amount of ^{149}Sm in an irradiated reactor fuel element. Appropriate measures are taken in order to reduce the sample quantity and minimize sources of error. Satisfactory results have been obtained.

II. Experimental

1. Instrumentation

This work was done using an MAT-260 mass spectrometer. A dual-band ion source was employed and a Faraday cup was used as an ion detector. A computer data acquisition system was employed.

2. Diluent

A solution of enriched ^{154}Sm ($C_{154} = 96.710\%$) was used as a diluent. Its concentration was calibrated against a standard solution of natural Sm. As a result, the concentration of the diluent is 0.9613 mg/g. The measured isotope abundance ratios are shown in Table 1.

Table 1. Isotope Abundance Ratios in Diluent

| $R_{144/152}$ | $R_{147/152}$ | $R_{148/152}$ | $R_{149/152}$ | $R_{150/152}$ | $R_{154/152}$ |
|---------------|---------------|---------------|---------------|---------------|---------------|
| 0.025 | 0.217 | 0.175 | 0.146 | 0.799 | 53.24 |

3. Sample Preparation

The fuel element was cooled, cut and dissolved in a heated HCl-HNO_3 solution³. An appropriate amount of diluent was added to it. The separated Sm sample was converted to the dilute nitrate form and then condensed to a mass spectrometer sample by resin extraction separation and high-pressure liquid chromatography (HPLC).

4. Determination of Abundance Ratio of Sm Isotopes in the Element

Prior to adding the diluent, a part of the treated element was put in the mass spectrometer to determine the isotope abundance ratio. The results are shown in Table 2.

Table 2. Measured Results of Sm Isotope Abundance Ratio in the Element Samples

| Solution # | $R_{147/152}$ | $R_{148/152}$ | $R_{149/152}$ | $R_{150/152}$ | $R_{151/152}$ | $R_{154/152}$ |
|------------|---------------|---------------|---------------|---------------|---------------|---------------|
| 1 | 2.766 | 0.496 | 0.030 | 1.815 | 0.090 | 0.202 |
| 2 | 3.409 | 0.222 | 0.092 | 1.872 | 0.245 | 0.180 |
| 3 | 2.968 | 0.376 | 0.048 | 1.807 | 0.134 | 0.190 |
| 4 | 2.703 | 0.534 | 0.031 | 1.836 | 0.086 | 0.217 |
| 5 | 2.811 | 0.475 | 0.037 | 1.824 | 0.100 | 0.220 |

5. Sample to Diluent Ratio

After the isotope abundance ratios of the sample and the diluent were determined, the sample to diluent ratio could be selected. In this work, $R_{154/152}$ was chosen to be the reference isotope ratio. Usually, this choice is made based on the optimal dilution condition and the ratio should be 1.8. However, based on the computation done in reference⁴, the increase in transfer error is still within tolerance when a sample to diluent ratio of 0.5 is selected. Therefore, even by keeping the total sample constant, the amount of sample required is cut in half. Consequently, the amount of radiation exposed to the operator is reduced. In this work, the sample of diluent ratio was close to 0.5.

6. Empty-Bank Treatment, Sample Drop Formation and Pre-heating of Sample

Empty-band treatment, drop formation and sample pre-heating are necessary procedures to go through prior to

each measurement. During this process, an automatic heating technique was used. This is a key step in achieving good reproducibility. In addition, it was found experimentally that an important step in obtaining a steady ion flow is to lower the pre-heating current after the sample is pre-heated to allow it to cool down for some time and then reheating it for measurement.

7. Measurement Conditions

The measurement conditions are as follows:

(1) Obtaining Metal Ions

When the ionization band temperature is low, there will be oxide-based ions. If oxide-based ions are used as the monitoring ions, oxygen isotope calibration must be done. In addition, there is the complicated isomer interference problem. In order to avoid this issue, a metal ion was selected as the monitoring ion in this work. As a

result of experimentation, the sample was in the form of a nitrate solution. The sample drop is approximately 1 μ g and the band thickness is 0.04 mm. When the ionization current was 6 A and sample band current was 2.4-2.8 A, a metal ion flow could be obtained at 2.5 V and it was stable for more than 3 hours.

(2) Reduction of Isomer Interference

When mass spectrometry is used to measure Sm isotopes, there is interference from isomers such as ^{144}Nd , ^{148}Nd , ^{150}Nd , etc. This is the major source of error. Therefore, during sample preparation, high-pressure liquid chromatography was used to separate out neodymium. As for the separation effect, a known mixture of natural Nd and Sm was used as a sample in an experiment and the results show that interference from Nd isotopes can be ignored, as shown in Figure 1.

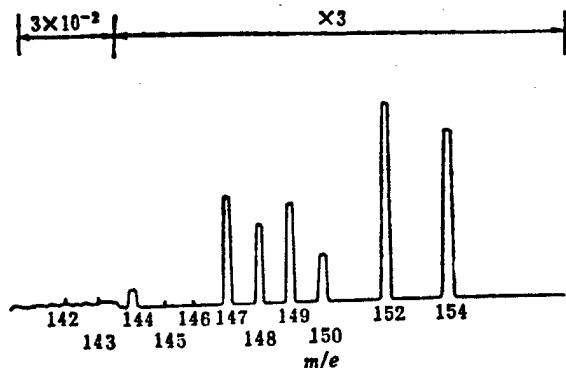


Figure 1. Mass Spectrum of Natural Sm in a HPLC-Treated Simulated Sample

Figure 1 does not show any Nd isotopes at mass numbers 142, 143, 145 and 146. The highest abundance ratio among natural Sm isotopes is ^{142}Nd (approximately 27.1%). It was not found even on a scale two orders of magnitude below that level.

(3) Selection of Reference Isotope

Sm is an element with multiple isotopes. During the process of selecting a reference isotope, factors such as ion flow intensity, isomer interference and mass differential were of primary concern. Based on the description concerning the effect of the error transfer factor and isotope ratio given in reference [4], ^{152}Sm was chosen as the denominator. Thus, the measurement error of the reference ratio relative to the error transfer factor is one order of magnitude lower than it would be while choosing ^{154}Sm as the denominator.

(4) Error Treatment

The overall error was treated using the equation derived in reference [4]. As for the instrumentation error, it was checked using the published value of natural Sm, and its effect on the final result was calculated. The overall error consists of measurement error and system bias. Through computation, the overall error ($\Delta x/x$) should be less than 0.6 percent. We believe that under the circumstances this treatment is more reasonable than using the published values for correction.

III. Results

In this work, ^{149}Sm accumulated in five fuel elements was quantitatively determined. The results are shown in Table 3. Through the (n, γ) reaction, ^{150}Sm is produced from ^{149}Sm . This is the major source of ^{150}Sm in the fuel element. Because ^{150}Sm is a stable nuclide, the determination of its content has a great deal of significance to understanding the distribution of ^{149}Sm . Table 4 shows the content of ^{150}Sm as measured by mass spectrometry.

Table 3. ^{149}Sm Content Measured by Mass Spectrometry

| Solution No. | x, μ g | ^{149}Sm , Wt% | Solution Weight, g | W_{149} , μ g/g Solution | $\Delta x/x, \%$ |
|--------------|------------|-------------------------|--------------------|--------------------------------|-------------------|
| 1 | 4.555 | 0.468 | 0.5840 | 0.0378 | plus or minus 0.5 |
| 2 | 2.820 | 1.311 | 0.5272 | 0.0701 | plus or minus 0.5 |
| 3 | 5.097 | 0.735 | 0.6610 | 0.0567 | plus or minus 0.4 |
| 4 | 5.675 | 0.486 | 0.5692 | 0.0825 | plus or minus 0.5 |
| 5 | 7.570 | 0.567 | 0.5562 | 0.0771 | plus or minus 0.4 |

x is the mean total weight of the element to be measured

Table 4. ^{150}Sm Content Measured by Mass Spectrometry

| Sample No. | ^{149}Sm , wt% | W_{150} , $\mu\text{g/g}$ solution |
|------------|-------------------------|--------------------------------------|
| 1 | 28.55 | 2.306 |
| 2 | 26.87 | 1.437 |
| 3 | 27.85 | 2.147 |
| 4 | 28.78 | 4.892 |
| 5 | 28.40 | 3.866 |

Let us divide the ^{149}Sm and ^{150}Sm content by the uranium content in their corresponding sample solutions in order to determine their relative ratios, as shown in Table 5, for comparison. This reflects the distribution pattern of the axial fuel fission of the element, as shown in Figure 2.

Table 5. Relative Ratios of Fission Products ^{149}Sm and ^{150}Sm

| Sample solution # | Sampling position, mm | Uranium content W_U , $\times 10^4 \mu\text{g/g}$ solution | W_{149}/W_U^* , $\times 10^6$ | W_{150}/W_U^{**} , $\times 10^6$ | ^{149}Sm content, relative units | ^{150}Sm content, relative units |
|-------------------|-----------------------|--|---------------------------------|------------------------------------|---|---|
| 2 | 179.75-200.25 | 3.668 | 1.912 | 0.392 | 1 | 1 |
| 3 | 477.75-500.25 | 2.627 | 2.158 | 0.817 | 1.129 | 2.086 |
| 5 | 691.75-712.25 | 3.342 | 2.307 | 1.157 | 1.207 | 2.952 |
| 4 | 858.5-879.00 | 3.612 | 2.285 | 1.354 | 1.195 | 3.457 |
| 1 | 1192.1-1212.6 | 1.879 | 2.013 | 1.227 | 1.053 | 2.678 |

* ^{149}Sm to U ratio in solution

** ^{150}Sm to U ratio in solution. The uranium content in the table is the mean of potentiometric titration, volumetric titration and mass spectrometry.

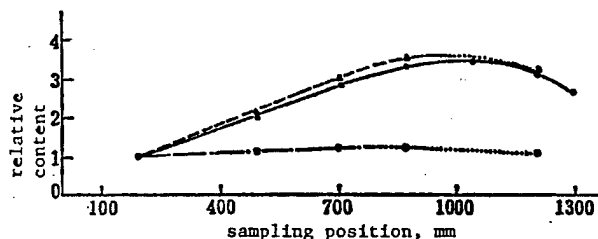


Figure 2. Axial Distribution of ^{148}Nd , ^{149}Sm and ^{150}Sm
 \bullet = ^{148}Nd ; \circ = ^{149}Sm ; Δ = ^{150}Sm ; in figure, axial distribution curve of ^{148}Nd is of data measured by mass spectrometry.

From Figure 2 we can see that ^{150}Sm and ^{148}Nd vary following the same pattern. Furthermore, this pattern agrees with the theoretical analysis.

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Study of Crossed-Field Gyrotron Operating in TEM11 Whispering-Gallery Mode

40100061A Beijing DIANZI KEXUE XUEKAN [JOURNAL OF ELECTRONICS] in Chinese Vol 12 No 3, May 90 pp 225-233

[English abstract of article by Luo Jirun [5012 4480 3387] and Zhang Shichang [1728 0013 2490] of the Institute of Electronics, CAS, Beijing; MS received 10 Feb 89, revised Jun 89]

[Text] A linear and nonlinear analysis of a crossed-field gyrotron operating in the TEM11 whispering-gallery mode are presented. Detailed discussions are given for the starting oscillation condition, the effect of the internal conductor in coaxial cavity on the cut-off frequency of mode and spacing between adjacent modes as well as the effects of the applied voltage on the electron cyclotron frequency, the starting oscillation beam power and electron efficiency. It is shown that an efficiency of 41 percent may be obtained for $m = 2$. A comparison of these results with those for a cylindrical cavity is made. The analysis is helpful for the engineering design.

Key words: Gyrotron; Whispering gallery mode; Starting oscillation condition; Beam-wave interaction.

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Study of the Output Ring Cavity for Secmotron

40100061B Beijing DIANZI KEXUE XUEKAN
[JOURNAL OF ELECTRONICS] in Chinese Vol 12 No
3, May 90 pp 234-240

[English abstract of article by Zhang Renshan [1728 0088 0810] of the Institute of High Energy Physics, CAS, Beijing, and Zhao Yongxiang [6392 3057 5046] of the Institute of Electronics, CAS, Beijing; MS received 4 May 88, revised 2 Aug 89]

[Text] Secmotron (Sector beam-deflection modulated tube) is a new kind of high-efficiency microwave tube which is developed on the basis of a gyrocon. Its pervance is higher than that of a gyrocon; therefore, the secmotron can be operated at rather lower voltage. Consequently, a double-ridge ring cavity is used as its

output. The ring cavity is analyzed with approximate methods. The design of the cavity and optimization of its dimensions are also given. The measured results of a test model are fairly coincident with the calculated ones.

Key words: Secmotron; Gyrocon; Resonator; Ring cavity

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Construction of a 6X6 BGO Array and Its Measurement of Low Energy Photons

40090018 Beijing GAONENG WULI YU HE WULI
[HIGH ENERGY PHYSICS AND NUCLEAR
PHYSICS] in Chinese Vol 15, No 3, Mar 90 pp 200-206

[English abstract of article by Gu Yifan, He Jingtang, et al., Institute of High Energy Physics, Academia Sinica]

[Text] A 6X6 BGO array as a prototype of precise fully active electromagnetic calorimeter has been constructed. It consists of 36 Chinese-made BGO crystals,

each being 20mm by 20mm in cross section and 200mm in depth, equipped with photomultiplier readout. To obtain linearity over a wide range, both the anode signal and a dynode signal were digitized. The array has been tested with monochromatic photons produced via (p,Y) reactions at the IHEP Van de Graaff accelerator in the energy range up to 21MeV. The response for photons has shown to be linear in this energy range. The FWHM energy resolution obtained follows a $E^{-1/2}$ dependence and is superior to that of BGO arrays reported in the literature.

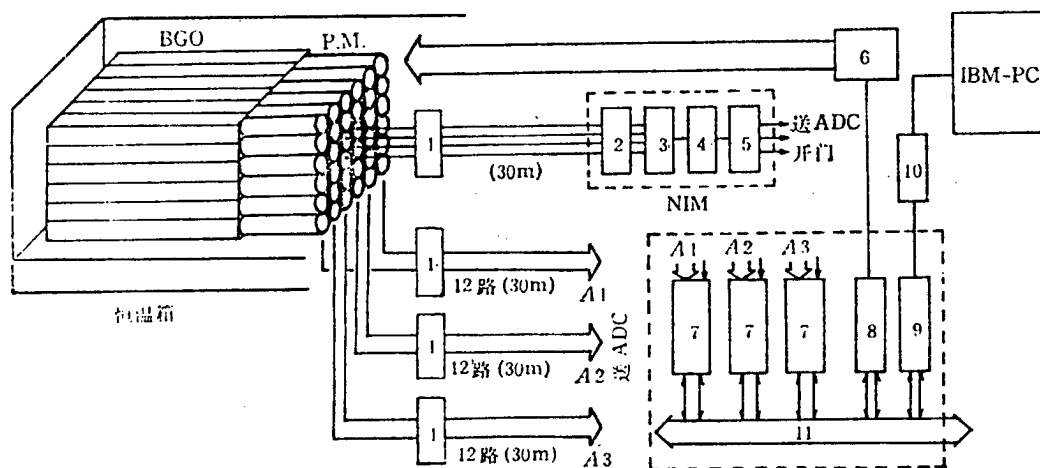


Figure 1. Diagram of Installation of 6X6 BGO Crystal Array

Key: 1. Front-end circuit 2. Discriminator 3. Gate 4. Double timer 5. Fan-out 6. High-voltage power source 7. ADC
8. C-139 9. CC-6002 10. PC-004 11. CAMAC DATAWAY

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